

REMARKS

The foregoing amendment cancels withdrawn claims 11-27 and adds claims 36-59. Pending in the application are claims 1-10 and 28-59, of which claims 1, 28, 53 and 55 are independent. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Applicants submit that claims 28-35 should be included in the examined claims, because these claims are readable on the elected species of claim 1.

New dependent claims 36-52 correspond to the subject matter of canceled claims 11-27, rewritten in dependent form to depend from claim 1.

New claim 53 corresponds to the subject matter of claim 1, rewritten to include the patentable subject matter of claim 2. New claim 54 depends from claim 53 and further specifies that the degree of sharpening is directly proportional to a degree of distortion in the image, as recited in original claim 1 and described throughout the specification.

Claim 55 corresponds to the subject matter of claim 1, and further specifies that the edge is sharpened by adjusting the intensity of pixel values near the edge, as set forth throughout the specification, at least, for example, on page 3, lines 29-31, and page 9, lines 6-31. New claims 56-59 depend from claim 55 and further specify subject matter found in original claims 1-35. *No new matter is added.*

Cancellation of the claims is not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action or the requirement for election in the Restriction Requirement, and was done solely to expedite prosecution of the application. Applicant reserves the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

35 U.S.C. §102 Rejections

Applicants thank the Examiner for the close review of the claims and for indicating that claims 2-10 recite patentable subject matter. In the Office Action, the Examiner rejects claim 1

under 35 U.S.C. §102(e) as being anticipated by the Lee reference (U.S. Patent Number 6,464,175). Applicants respectfully traverse the rejection and submit that the Lee reference does not disclose a method of sharpening an edge in an image to a degree directly proportional to a degree of distortion of the image, as recited in claim 1.

The Lee reference describes an image processing system for extracting and enhancing features in an image to remove noisy and irrelevant information from the image. The Lee reference does not disclose *sharpening* an edge in an image, or sharpening an edge in an image by a degree that is directly proportional to a degree of distortion in an image, as recited in claim 1.

As set forth in the present application, “sharpening” of an edge refers to accentuating a contrast between a bordering dark region and an adjacent light region. (See page 1, lines 11-12, page 3, lines 24-26 and Figures 7A, 7B, 8A and 8C.) In particular, the claimed method allows for sharpening based on an amount of distortion in the signal, which may be caused by printing and/or scanning of the image. As shown in Figures 3B-3C and described in the specification on page 6, lines 16-30, distortion refers to a corruption of a data signal in an edge region whereby the signal *merges* the intensity levels between the two regions, rather than transition sharply between the two regions. Figure 3A illustrates an undistorted signal, with a sharp transition, while Figures 3B and 3C illustrate a distorted signal having a more gradual transition between two regions on either side of an edge.

In one embodiment of the invention, edges are enhanced by altering the manner in which a halftone print engine places ink at an edge of a printed image. The claimed method of sharpening may manipulate the image signal in an edge region to increase the intensity level of output pixels on the light side of the transition and to decrease the intensity level of output pixels on the dark side of the transition. The effect is that pixels in the light region of the edge are further lightened and pixels in the dark region of the edge are further darkened, thereby increasing the contrast in an edge region and preventing the printer from placing ink on the light side of the transition.

The claimed invention is not concerned with removing noise in the image signal, as described in the Lee reference, but rather, with ensuring a sharp transition in the edge region.

The Lee reference is directed to an image processing method that removes noise, but does not sharpen an edge in an image, nor does the Lee reference compensate for any distortion in a signal. For example, as shown in Figures 9A-9E and 11A-11C, even after removal of noise from an image signal, the image signal still does not provide a sharp transition between two regions of an image. The intensity level on each side of an edge in Lee is *averaged* or *smoothed out* to remove noise, but the intensity level is not modified to increase a contrast between either side of the edge. In contrast to the Lee reference, the claimed invention *accentuates* a contrast between two regions and compensates for distortion to provide a sharp transition between different regions on either side of an edge.

For at least these reasons, claim 1 distinguishes patentably over the Lee reference without amendment, and the rejection under 35 U.S.C. §102(e) should be reconsidered and withdrawn.

New Claims

New dependent claims 36-59 have been added to more fully claim the instant invention. Claims 36-52 depend from claim 1 and are therefore also allowable. In addition, dependent claims 36-52 recite additional patentable features not taught or suggested in the Lee reference.

For example, the cited references fail to disclose a method of compensating for distortion at an edge of an image that includes the step of applying a filter to the image at a detected edge to adjust the intensity of pixel values near the edge in order to compensate for a blurring effect that occurs at the edges during scanning of the image, as set forth in claim 36.

The cited references also fail to disclose compensation for distortion that occurs during printing of an image, as set forth in claims 37 and 41.

The cited references also fail to disclose application of a filter to sharpen an edge that includes applying a negative gain to the area of low intensity that is adjacent to the edge and applying a positive gain to the area of high intensity that is adjacent to the edge to increase contrast between the area of low intensity and the area of high intensity while maintaining a constant average intensity level, as recited in claims 38 and 42.

The cited references also fail to disclose application of a filter to sharpen an edge that includes applying a first negative gain and a first positive gain to the area of low intensity that is adjacent the edge and applying a second negative gain and a second positive gain to the area of high intensity that is adjacent the edge to increase contrast between the area of low intensity and the area of high intensity while maintaining a constant average intensity level, as recited in claims 39-40 and 43-44.

The cited references also fail to disclose detection of an edge within a window of pixels in the image comprising a first pixel, a first set of context pixels located immediately adjacent to said first pixel in a first direction, a second pixel located immediately adjacent to said first pixel in a second direction, and a second set of context pixels located immediately adjacent to the second pixel in the second direction, as set forth in claims 45-46. In addition, the cited references fail to disclose shifting such a window in a linear direction in order to detect and sharpen additional edges of the image, as set forth in claim 46.

Furthermore, the cited references fail to disclose a method of sharpening edges in an image wherein the sharpening is applied only at detected edges of the image, while smooth transition areas of the image remain unaffected, as set forth in claim 47.

The cited references further fail to disclose execution of a method of sharpening images on an electronic device that comprises a scanner for scanning an original image and converting the image into a digital image signal comprised of pixels having an intensity value that ranges from a minimum intensity to a maximum intensity, a printer using an error diffuser and a digital signal processor that includes a filter for sharpening edges of the image in order to compensate for distortion of the edges that occurs during scanning and printing of the image, as set forth in claims 48-52. In particular, the cited references fail to disclose a filter that forces the error diffuser in an edge region to place a dot in the area of high intensity only and prevents the placement of a dot in the area of low intensity, as set forth in claim 50.

Independent claim 53 is directed to the patentable subject matter of claim 2, rewritten in independent form. As recognized by the Examiner, the cited references, in particular the Lee reference, do not disclose a step of detecting an edge in an image that comprises the steps of

defining a first context and a second context for two adjacent pixels in the image, measuring an average intensity value of the first context and an average intensity value of the second context, computing a difference value by subtracting the average intensity value of the first context from the average intensity value of the second context, and determining whether the first and second pixel comprise an edge by examining the difference value. Therefore, claim 53 is immediately allowable. Claim 54 depends from claim 53 and is also immediately allowable.

Independent claim 55 is directed to the subject matter of claim 1 and further specifies that sharpening comprises adjusting an intensity of pixel values near the edge, a feature not taught or suggested in the Lee reference or the other references cited by the Examiner. Claims 56-59 depend from claim 55 and are also immediately allowable.


CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Applicant believes no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. OAQ-021 from which the undersigned is authorized to draw.

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Respectfully submitted,

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